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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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INVENTOR(S)

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☐ *Additional inventors are being named on the _______ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

Radial Flow Filter With Spray Liner

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ENCLOSED APPLICATION PARTS ***(check all that apply)***

[X] Specification *Number of Pages* 14
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☐ Application Data Sheet. See 37 CFR 1.76
☐ CD(s), Number
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Respectfully submitted,

SIGNATURE Roger N. Chauza

Date July 1, 2003

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REGISTRATION NO. *(if appropriate)* 29,753

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USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

JMAR-0401PV

Prov. Patent

RADIAL FLOW FILTER WITH SPRAY LINER

By:

John D. Martin

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Roger N. Chauza (Name of Depositor)

Roger N. Chauza
Signature
Date of Signature: July 1, 2003

Technical Field of The Invention

The present invention relates in general to filters, and more particularly to radial flow filters of the type that are fluidizable.

Detailed Description

Fig. 1 illustrates the filter 10, although in practice it may be much longer in length, namely about six foot. The filter can be constructed in sections, each about four inches in length. Thus, to manufacture filters of different lengths, a different number of sections would be used. The sections can have male/female ends which can be solvent welded or spin welded together to provide a reliable integral structure. Preferably, two sections would be added together, one associated with the filter end and one associated with the backwash end of the unit. The filter 10 includes a top end cap12 and a bottom end cap 14. Both top and bottom end caps 12 and 14 may be constructed in an identical manner, using the same mold. The end caps can be constructed of plastic, metal or other suitable material.

Supported between the end caps 12 and 14 is an outer cylindrical case 16 that is supported between respective annular recesses in the top and bottom end caps 12 and 14. The case 16 can be welded or threaded to the top and bottom end caps 12 and 14 to constrain the perforated cylinders 22 and 32 between the end caps 12 and 14. O-rings 18 and 20 provide a fluid seal between the case 16 and the top and bottom end caps 12 and 14. Rather than using O-rings, an alternative could be welding and/or potting the parts together.

The top and bottom end caps 12 and 14 further include other respective annular recesses for supporting therebetween an outer perforated cylinder 22. The outer perforated cylinder 22 may be plastic or metal with large openings 24 formed therein. The openings 24 are formed only in the bottom half of the outer perforated cylinder 22. A screen 26 is attached to the inside surface of the outer perforated cylinder 22. O-rings 28 and 30 provide a fluid seal between the outer perforated cylinder 22 and the respective top and bottom end caps 12 and 14.

An inner perforated cylinder 32 is supported within respective bores formed centrally in

the top and bottom end caps 12 and 14. O-rings (not shown) provide a fluid seal between the ends of the top and bottom ends of the inner perforated cylinder 32 and the respective bores of the top and bottom end caps 12 and 14. Large perforations 34 are formed in the inner perforated cylinder 32 from the top to the bottom thereof. A screen 36 is attached to the outer surface of the inner perforated cylinder 32.

An annular chamber 38 is located between the outer screen 36 of the inner perforated cylinder 32 and the inner screen 26 of the outer perforated cylinder 22. Media beads 40 partially fill the annular chamber 38, called the media chamber 38. The media beads 40 are larger in diameter than the screens 26 and 32. The media beads 40 can be injected or removed from the media chamber 38 by way of a channel 44 located in the top end cap 14 or a channel 42 located in the bottom end cap 14. During the media coacting or filter stage, the media beads 40 are located in the bottom of the filter 10. During a fluidization stage, the media beads are lifted to the upper portion of the media chamber 38.

The inner perforated cylinder 32 has a plug 46 located centrally therein to prevent fluid flow through the central core of the inner perforated cylinder 32. Located below the plug 46 inside the inner perforated cylinder 32 are a number of orifice plates, one shown as reference character 48, to allow a controlled flow of fluid inside the inner perforated cylinder 32. The orifice size within each orifice plate 48 is smaller in diameter than that of the orifice located below it. The orifices function to allow the sequential fluidization of the media beads 40. The bottom end cap 14 includes a funnel-shaped surface formed at the bottom of the media chamber 38. This upwardly slanted surface facilitates fluidization of the media beads 40. Reference is made to U.S. Pat. 6,322,704 by Martin for a further description of the fluidization process in a radial flow fluidizable filter. The disclosure of such patent is incorporated herein by reference.

Located above the plug 46 near the top of the inner perforated cylinder 32 is a ball and seat valve 50. The ball is captured by a screen cage fastened to the upper surface of the seat

plate of the valve 50. The cage prevents the ball from being carried away with the backwash fluid. The cage can be constructed of other structures to contain the ball, such as a rod inserted laterally through the tubular inner perforated cylinder 32.

The upper end of the inner perforated cylinder 32 opens into a central port 52 formed within the top end cap 12. In like manner, the bottom end of the inner perforated cylinder 32 opens into a central port 54 formed in the bottom end cap 14.

Formed in the top and bottom end caps 12 and 14 are respective annulus ports 56 and 58. The top port 56 opens into an annular channel 60 formed in the top end cap 12. Similarly, the bottom port 58 opens into an annular channel 62 formed in the bottom end cap 14. The annular channels 60 and 62 are in fluid communication with an annular chamber 64 located between the outer surface of the outer perforated cylinder 22 and the inside surface of the case 16.

Just subsequent to the backwash cycle and prior to the filter cycle described below in connection with Fig. 2, a short "purge" cycle is initiated to quickly return the media beads 40 to the bottom of the annular chamber 38 and purge the inner screen 26 (lining the inside of the outer perforated cylinder 22) of accumulated residue filtered from the influent. The purge cycle is initiated by briefly closing valve 51, and closing the valve at the bottom of port 54, opening the valve at the bottom of port 58, and forcing the influent (or other purging liquid) downwardly into the inner perforated cylinder 32. The downward flow of the purging liquid is in the direction of arrows 53, which is effective to force the media 40 from the top of the annular chamber 38 to the bottom of such chamber 38. Once the media 40 has begun to settle to the bottom of the annular chamber 38, the residue that may have accumulated on the screen 26 during the previous filter cycle is dislodged and flushed out through the port 58 to a drain. As the media beads 40 become compacted, starting at the bottom of the annular chamber 38 and becoming compacted upwardly, the accumulated matter or residue is also dislodged from the screen 26 in an upward manner. This is done one row of horizontal holes at a time from the

bottom to the top as the media contacts the bottom and accumulates in the bottom filter chamber from the bottom up. The downward fluid flow from the top down is continually forced radially outward as it comes into contact with the top of the media layer which is constantly changing as the media accumulates and fills up the bottom filter chamber. This concentration of flow at each row of holes maximizes the mass and velocity of the flow impacting the screen at any give time. This is in contrast to contacting the entire screen and annular space at the same time which would drastically reduce the amount of flow per unit area and thus the velocity and mass and therefore impact per unit area as is typically done with other filters except in the cases where mechanical devices are employed which is quite expensive. Once the screen 26 is purged of the residue, the valve at annulus port 58 is closed, the valve at the bottom central port 54 is opened, and the valve 51 at the top annulus port 56 is opened. This completes the purge cycle, which may take on the order of a few seconds. Air can be added when required to enhance the purge cycle.

Fig. 2 illustrates the filter 10 during a filter stage where particulate matter is removed from the influent. The influent is coupled via external piping and valve arrangement to the central inlet port 52 as well as the annulus inlet port 56. The influent is forced downwardly into the top of the annular media chamber 38 to push the media 40 downwardly to the bottom of the chamber 38. In addition, any influent that passes through the annular column of media particles is effectively filtered. Influent also passes into the annulus port 56 and around the annular chamber 64 and through the bottom openings in the outer perforated cylinder 22. This influent passes radially through the media 40 and is filtered. The filtered influent passes through the media 40 and through the openings in the inner perforated cylinder 34 and downwardly in the core of the inner perforated cylinder 34 to the central outlet port 54. In this configuration, the media ports 44 and 42 are capped or otherwise valved to a closed position. The bottom annular chamber port 58 is also capped or valved to a closed position.

With the construction of the top and bottom end caps 12 and 14, a media exchange cycle

is made possible. In filter or media coaction systems, the media often needs to be replaced or regenerated. Usually, this requires the disassembly of the filter or removal of the filter from the system. In the present filter, all that needs to be done is the use of a media exchange cycle, where the spent media is removed from the system via the media ports 42 or 44. Preferably, the media is removed via the top media port 44 during a fluidizing cycle. Conventional valves (not shown) can be used to automatically or manually control the opening and closing of the media ports 42 and 44. The spent media can then be disposed of or other wise regenerated. The regenerated media, or a new or different media can then be injected into the filter via one or both media ports 42 or 44. The media that may be used includes traditional beads for filtering particulate matter, activated carbon media, ion exchange media, and many other types of media. Accordingly, if a different fluid is to be processed through the filter of the invention, it is simple matter to equip the filter with the appropriate media without any disassembly of the filter.

The filter process continues until the media has accumulated particulate matter to the extent that the pressure in forcing the influent into the filter 10 increases above a predefined threshold. In this event, a backwash procedure can be instituted.

The backwash stage is shown in Fig. 3. Here, the external valving arrangement is switched so that the backwash fluid enters the filter 10 via the bottom central port 54. The backwash fluid is forced into the central core of the inner perforated cylinder 32. The backwash fluid is forced to flow through the orifices in the plates and outwardly through the openings 34 in the inner perforated cylinder 32. Reference is made to U.S. Pat. No. 6,322,704 for the structure of the orifice plates 48 in the inner core of the perforated cylinder 32 that allows sequential fluidization of the media 40. In any event, the backwash fluid fluidizes the media 40 and separates the particulate matter from the media 40. During fluidizing, the media 40 is raised to the upper end of the annular media chamber 38. When raised upwardly, the media 40 is cleaned. The backwash fluid and the particulate matter are carried upwardly back into the inner core of the upper half of the inner perforated cylinder 32 and out of the upper most ball/seat 50. The

backwash fluid and particulate matter are carried out of the central port 52. The upper annulus port 56 may be valved to a closed position, as shown, or open to purge the outside annular of any entrapped solids - this port may be open intermittently or continuously throughout the backwash cycle. It should be noted that air can be used in the backwash cycle to facilitate fluidizing and cleaning of the media.

Fig. 4 illustrates another embodiment of the top and bottom end caps according to the invention.

Fig. 5 is a drawing of another embodiment of a set of radial flow filters connected in a series relationship. In this embodiment, the filter 70 includes a spray liner 72 located between the outside casing 74 and the middle perforated core 76. The middle perforated core 76 is constructed with large perforations on the bottom half thereof. Between the middle perforated core 76 and the spray liner 72 is an annulus 78. Located in the axial center of the filter 70 is a perforated center core 80. The perforated center core 80 has large perforations along the entire length thereof. A plug 86 is attached to the internal part of the perforated center core 80 to prevent fluid flow directly between the upper portion of the perforated center core 80 and the lower portion thereof. A screen (not shown) is attached to the inner surface of the middle perforated core 76, and a smaller-diameter screen (not shown) is attached to the outer surface of the perforated center core 80. Both screens have openings smaller than the size of the media beads 82 located in the annular column 84 between such screens. The media beads 82 fill the annular column 84 about half way.

A top end cap is made with a media changeout line 88 in the top of the filter in communication with the annular column 84. A bottom end cap is similarly made with a media changeout line 90 in the bottom of the annular column 84. Media beads 82 can be input and removed via such lines 88 and 90. The top end cap is also constructed with an inlet port 92 in communication with the annular 78 between the middle perforated core 76 and the spray liner

72. In like manner, the bottom end cap is constructed with a port 94 in communication with the bottom of the annular 78. As will be described below, the ports 92 and 94 can be used to remove from the filter 70 residue that was caked on the outer surface of the middle core screen. The top and bottom end caps are constructed with a respective top central port 96 and a bottom central port 98. Lastly, the bottom end cap is constructed with a port 100 connected to the annular space 102 between the outside casing 74 and the spray liner 72. The top end cap 12 can also be constructed with a similar port connected to the annular space 102.

The spray liner 72 is constructed using a rigid cylindrical tube, such as a PVC pipe or other suitable material, with nozzles formed therein. The nozzles, which may be holes or other nozzle structures, one shown as reference numeral 104, are of such a size that a spray stream is formed and directed to the screen attached to the middle perforated core 76. Of course, the size of the nozzles 104 are a function of the pressure of the liquid injected into the annular space port 100. In addition, the nozzles 104 are formed uniformly around the spray liner 72, and only in the bottom half thereof.

The filter 110 is constructed in a manner substantially identical to the filter 70 described above. The two filters 70 and 110 are connected together by a system of valves, check valves and other apparatus to direct the flow of influent through the filters 70 and 110 in series. To that end, the media beads in the downstream filter 110 can be smaller to thereby filter smaller-size particulate matter from the influent coming from the first filter 70.

In a filter cycle, influent comes to the first filter 70 from a fluid to be filtered, via solenoid valve SV1 and gate valve GV1. The influent is directed to the top central port 96 as well as to the annular port 92 via the ball valve BV1 and solenoid valve SV4. The filtering of the influent is carried out very much like the filter embodiment described above in connection with Figs. 1-3. The filtered effluent is carried out of the bottom central port 98 of the first filter 70 to the top central port 112 of the second filter 110 via valves SVA, CV3 and BV5, and to the

annular port 114 via valves BV3 and SV5. The influent to the second filter 110 is filtered and carried away as filtered fluid via the central outlet port 116 to a filtered fluid pipe or reservoir via valve SV2. Accordingly, the influent passes serially through the first filter 70, and then through the second filter 110. As can be appreciated, after a period of filtering of influent, particulate matter clogs the spaces between the media beads 82, and larger particulate matter becomes caked on the outer surface of the screen attached to the inner surface of the middle perforated core 76. The fluidizing of the media beads 82 is effective to remove the particulate matter clogging the spaces between the media beads 82, but is not substantially effective in removing the caked particulate matter on the screen attached to the middle perforated core 76.

Prior to the fluidizing cycle, a spray cycle is carried out. In a spray cycle, a pressurized liquid is injected into the lower port 100 and thus pressurizes the annular space 102. Preferably, although not by way of necessity, the annular space 78 is drained so as to be empty of fluid before the pressurizing spray cycle. However, it is envisioned that it would be effective even if the annular space 78 has a liquid therein. In any event, a spray liquid, such as water or any other suitable solvent, is pumped from the spray supply tank through SV6 and GV2 into the bottom port 100 coupled to the annular space 102. The annular space 102 is thus pressurized, whereupon a high pressure stream is directed through the nozzles 104 and onto the screen attached to the middle perforated core 76. The high pressure spray streams are effective to remove the caked particulate matter from the screen. The caked particulate matter is removed from the filter 70 by way of the bottom port 94 through a valve, not shown. Alternatively, or in addition, the dislodged particulate matter can be removed from the filter 70 via the top port 92 and the valve PRV1. It is anticipated that the filters 70 and 110 would undergo spray cycles one at a time, to make more effective the pressurized fluid in one filter, rather than sharing the pressurized fluid at the same time between the filters 70 and 110.

In addition to the use of high pressure spray streams to dislodge the caked particulate matter on the screen attached to the middle perforated core 76, air pressure can also be injected

into the spray streams. The injection of steam or other fluid is also an alternative. A source of air pressure 120 is connected to the bottom port 100 of the filter 70 by way of valves BV7 and GV2. The air can be injected into the high pressure stream to create turbulent fluid flow and thereby more effectively dislodge the caked particulate matter from the screen. Air pressure is also coupled to the annular space port of the second filter 110 by way of valves BV7 and GV3.

The fluidization of the media beads 82 can be carried out after the spray cycle. It is envisioned that there may not need to be a fluidization cycle for every spray cycle. Rather, the filter can undergo a fluidization cycle after multiple spray cycles. In a fluidizing cycle, or backwash cycle, the backwash fluid is obtained from a backwash supply tank. The backwash fluid is directed to the bottom central port 98 of filter 70 via valves SV7, CV4, FC1 and SVB. The media beads 82 are fluidized, whereupon the particulate matter is carried away with the backwash liquid via top central port 96 and valves CV1and SVD to the drain. In addition, the backwash fluid and particulate matter are carried away via the top annular port 92, valves SV4, BV1, CV1 and SVD to the drain. At the same time the first filter 70 is backwashed, the second filter 110 also undergoes a backwash cycle. The backwash liquid is directed through SV7, CV5 and FC2 to the bottom central port 116 of the second filter 110. The backwash fluid and particulate matter exit the top ports 112 and 114 of the second filter 110, and are carried to the drain via the valves CV2 and SVD (from top central port 112) and valves SV5, BV3, CV2 and SVD (from top annular port 114).

Fig. 6 illustrates another embodiment in which the filters 70 and 110 are connected in parallel. The filters 70 and 110 otherwise function in the same manner as described above in connection with the Fig. 5 embodiment. The influent is coupled to the first filter 70 and the second filter 110 in parallel. The influent is carried to the first filter 70 via the top central port 96 through valves SV1, GV1 and BV6, and to the annular port 92 via additional valves BV1 and SV4. The influent is also carried from valve GV1 to valves CV1, CV2 and BV9 to the central port 112 of the second filter 110, as well as through valves BV3 and SV5 to the annular port 114

of the second filter 110.

The filtered fluid is carried out of the bottom central port 98 of the first filter 70 to the filtered fluid pipe or reservoir, via valves SVA, CV3 and SV2. The filtered fluid from the second filter 110 is carried from the bottom central port 116 to the filtered pipe or reservoir by valve SV2. As can be seen, the filters filter the influent in parallel, thereby increasing the filtering capacity of the system.

The spray and the backwash cycles are carried out in much the same manner as described above.

It is noted in Figs. 5 and 6 that the system uses solenoid valves SVA and SVB to control routing of fluid during the filter cycle and the backwash cycle. While the use of solenoid valves is acceptable, such valves are expensive. As an alternative, Figs. 7 and 8 show the construction of a simple valve 120 that accomplishes the same purpose as described above in connection with the solenoid valves SVA and SVB. Fig. 7 shows the valve operation during a filter cycle, and Fig. 8 shows the valve operation during a backwash cycle. Importantly, the valve 120 does not use any electrically controlled apparatus and has few parts. The valve 120 may be constructed of plastic, metal or any other suitable material. The valve 120 includes three ports 122, 124 and 126. Two balls 128 and 138 are located in specified areas of operation. The balls 128 and 138 are constructed of a solid material that is heavier than the fluid being processed through the valve 120. If water is the basic fluid being processed, then balls made of Teflon or an acrylic material can be used. The balls 128 and 138 can also be spring biased downwardly, rather than moved solely under the influence of gravity. The ball 128 can move down into engagement with a seat 132 and close off downward fluid movement in valve leg 134. The ball 128 can move upwardly and bump against a stop 136. The stop simply prevents upward movement of the ball 128, but does not interfere with fluid flow. The stop can be a small-diameter rod fixed transverse within the section 134. The ball 138 is constrained generally in the area 140 by a first

stop142, a second stop 143 and a seat 146.

If fluid is flowing upwardly with respect to ball 128, then the ball 128 will rise against the stop 136 and allow fluid to pass upwardly through the valve section 134 from port 126 to port 122. If fluid attempts to flow downwardly in valve section 134, then the ball 128 is forced downwardly into engagement with the seat 132 and prevents the downward flow of fluid. With regard to the ball 138, if fluid flows upwardly in valve section 140, then the ball 138 is carried with the fluid and is lodged in the seat 146, due to a pressure difference across the seat 146. Fluid flow is thus blocked from flowing to the port 124. Once fluid flow is stopped or otherwise momentarily interrupted through the valve 120, the ball 138 drops onto the stop 142. Then fluid flow from the valve port 122 to port 124 is possible.

As can be seen from Figs. 5 and 7, in a filter cycle, the filtered effluent can flow from the bottom central port 98 of the filter 70 through valve port 122 to valve port 124, to inlet ports 112 and 114 of filter 110 (Fig. 5). The down line check valve CV4 prevents fluid flow downwardly through port 126 of the valve 120.

In Fig. 8, the backwash cycle is carried out through the valve 120 in the following manner. The upward flow of fluid carries ball 128 upwardly against the stop 136, thus allowing fluid to flow upwardly from the bottom port 126 to the top port 122. In addition, the upward flow of fluid carries the other ball 138 upwardly into engagement with the seat 146, thus preventing fluid flow into the valve port 124. Accordingly, fluid also flows through valve section 140 to the top port 122. It can thus be seen that the valve 120 can be used instead of two solenoid actuated valves SVA and SVB of Figs. 5 and 6. The valve 120 can be utilized in many other system applications.

It should be noted in the foregoing description that the filters have been described in a down flow configuration, where the influent flows downwardly through the filters during the

filter cycle. In the down flow configuration, the filter chamber is at the bottom of the filter, and the backwash chamber is at the top of the filter. The filters described above can also be used in an up flow configuration where the influent flows upwardly through the filter. In the up flow configuration, and the filter chamber with the media bed is located at the top of the filter, and the backwash chamber is located at the bottom of the filter.

From the foregoing, disclosed are filter embodiments that make the filtering and cleaning cycles more effective.

What Is Claimed Is:

1. An end cap for a filter, comprising:

an end cap structure having a large diameter annular recess and a smaller-diameter recess;

a central bore formed through the end cap structure;

a funnel-shaped surface located between the central bore and the smaller-diameter recess;

an annular channel formed around the end cap structure, and a bore formed from an end surface of the end cap structure to the annular channel; and

a bore formed through said end cap structure from the end surface to the funnel-shaped surface.

2. A filter, comprising:

an outer casing;

a middle perforated core;

a spray liner located between said outer casing and said middle perforated core, said spray lining having nozzles or holes formed therein;

a space between said outside casing and said spray liner defining an annular space;

a perforated center core having perforations along the length thereof, said perforated center core located inside said middle perforated core;

a screen lining an outside surface of said perforated center core, and a screen lining an inside surface of said middle perforated core, a space between said screens defining an annular column for holding media beads; and

a source of pressurized fluid injected into the annular space between said outside casing and said spray liner, whereby jet streams are directed through said nozzle holes to the screen lining the inside of said middle perforated core to thereby dislodge caked particulate matter on said screen.

3. A valve (120), comprising:

a first port (122), second port (124) and third port (126);

a valve body having sections (134, 140) branched from said third port (126);

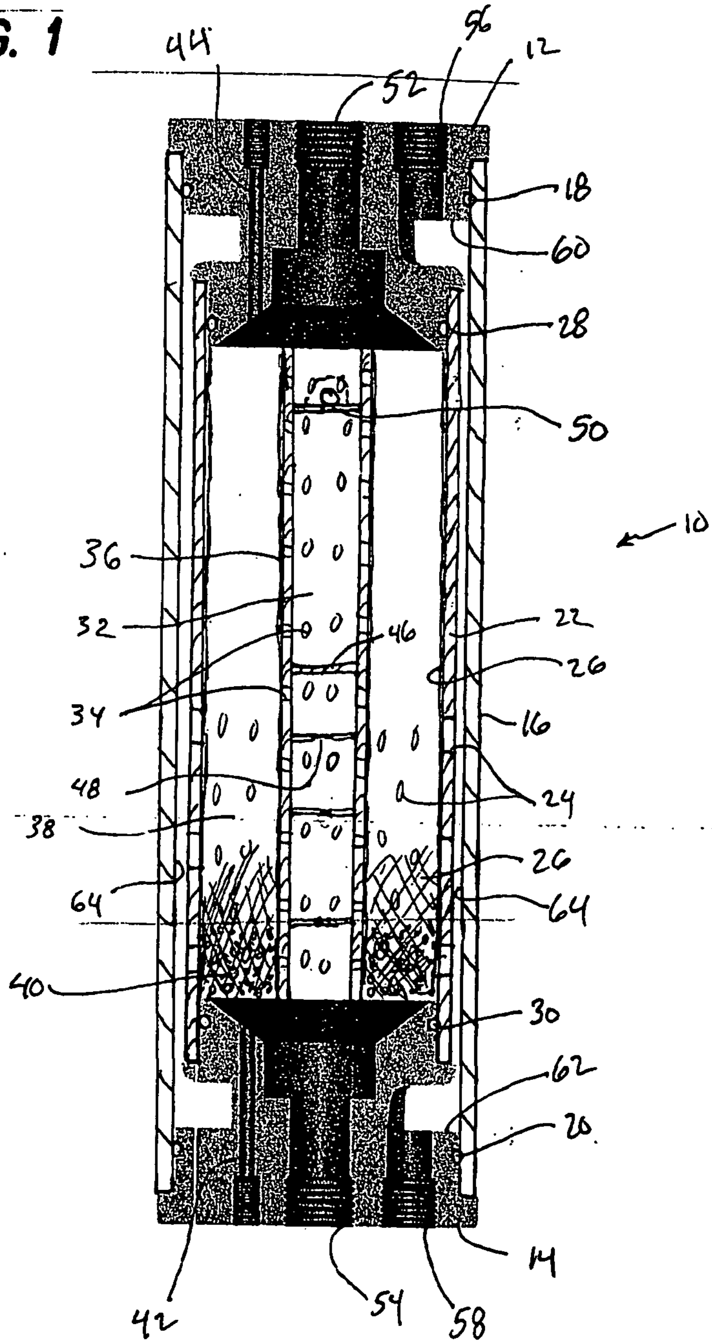
a first ball (128) contained in said section (134) by a seat (132) and a stop (136);

a second ball (138) contained in said section 140 by a stop (142);

said balls (128, 138) being constructed with a material heavier than a fluid to be processed by said valve (120); and

a seat (146) associated with said ball (138), said seat (146) located in said second port (124)

FIG. 1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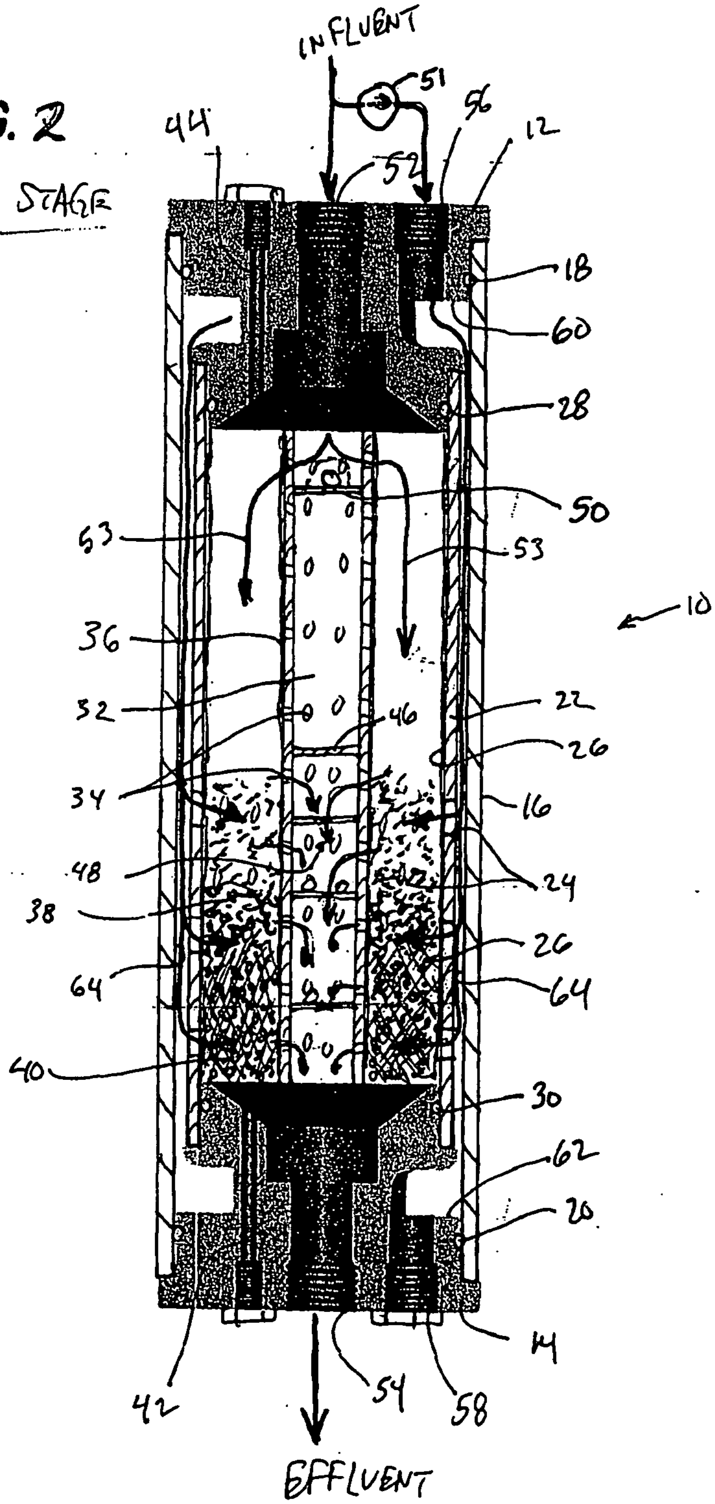

FIG. 2

FILTER STAGE

FIG. 3

BACKWASH STAGE

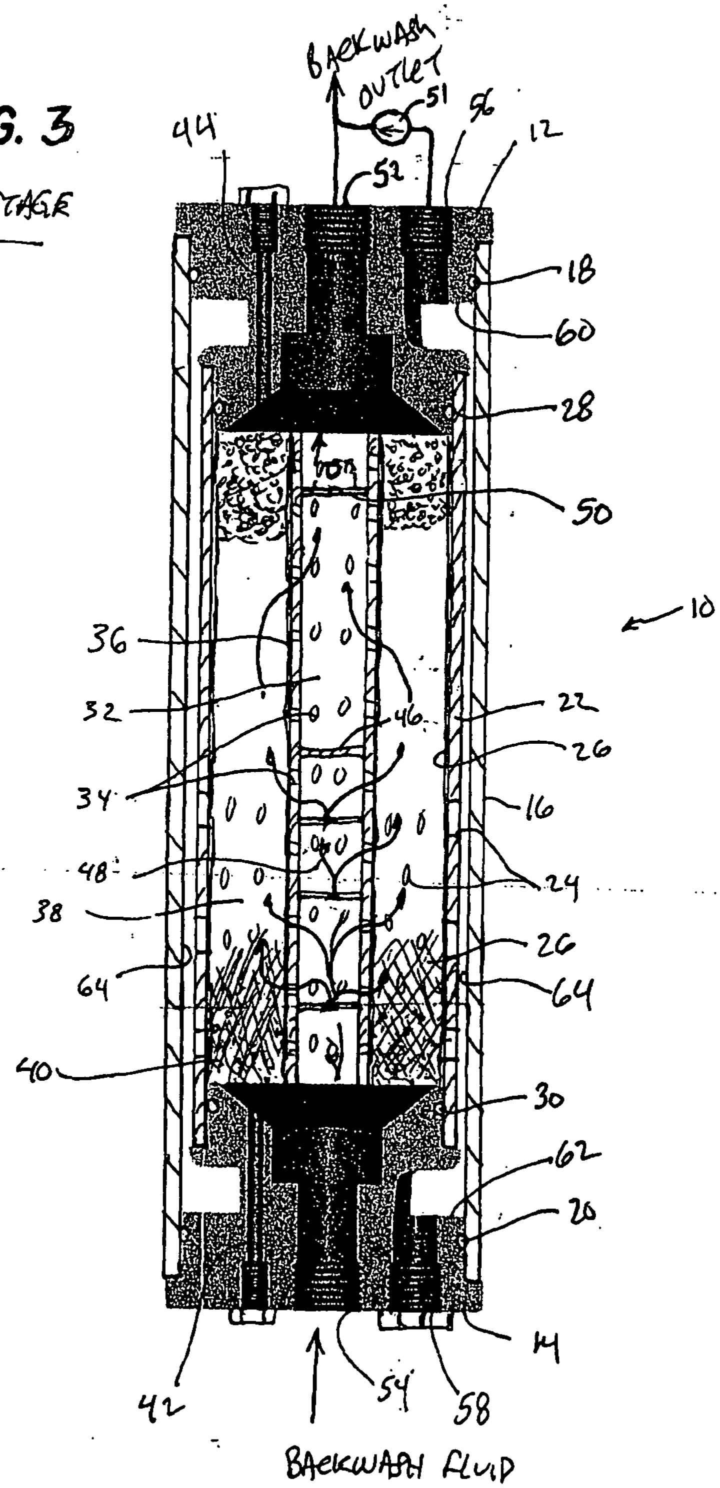

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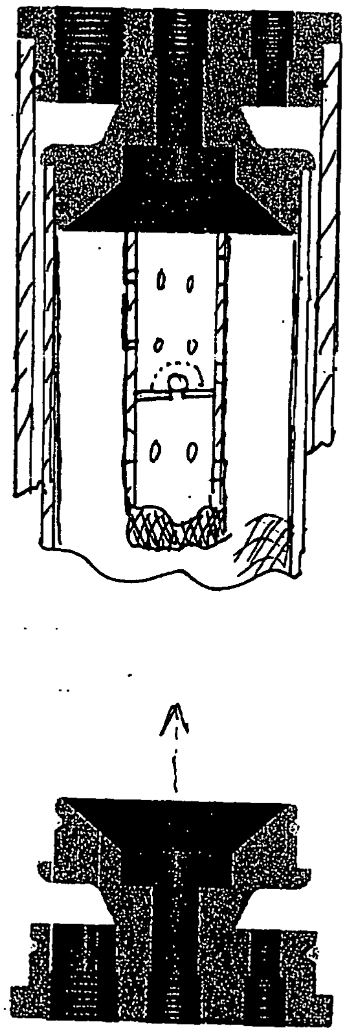
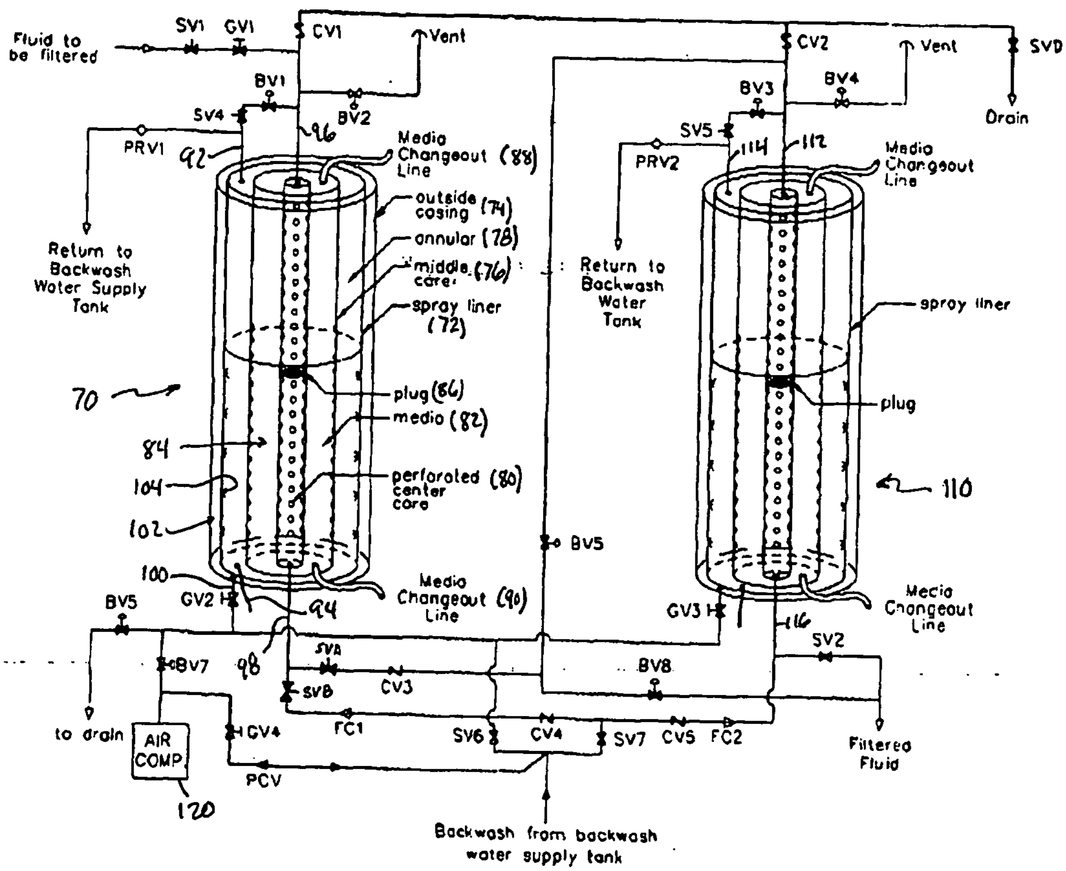
FIG. 4



LEGEND	
SV	Solenoid Valve
MCV	Martin Check Valve
CV	Check Valve
GV	Gate Valve
BV	Ball Valve
FC	Flow Control
PCV	Pressure Control

FILTER SPECIFICATIONS
TOTAL LENGTH = 1782mm (70 3/16")
OUTSIDE DIAMETER = 188.3mm (6 5/8")
HEIGHT OF FILTER = 750mm (29 1/2")
HEIGHT OF PERFORATED AREA BELOW PLUG = 660mm (26")
SURFACE AREA FOR FILTRATION = 0.23m² (2.5ft²)

FIG. 5



NOTES:

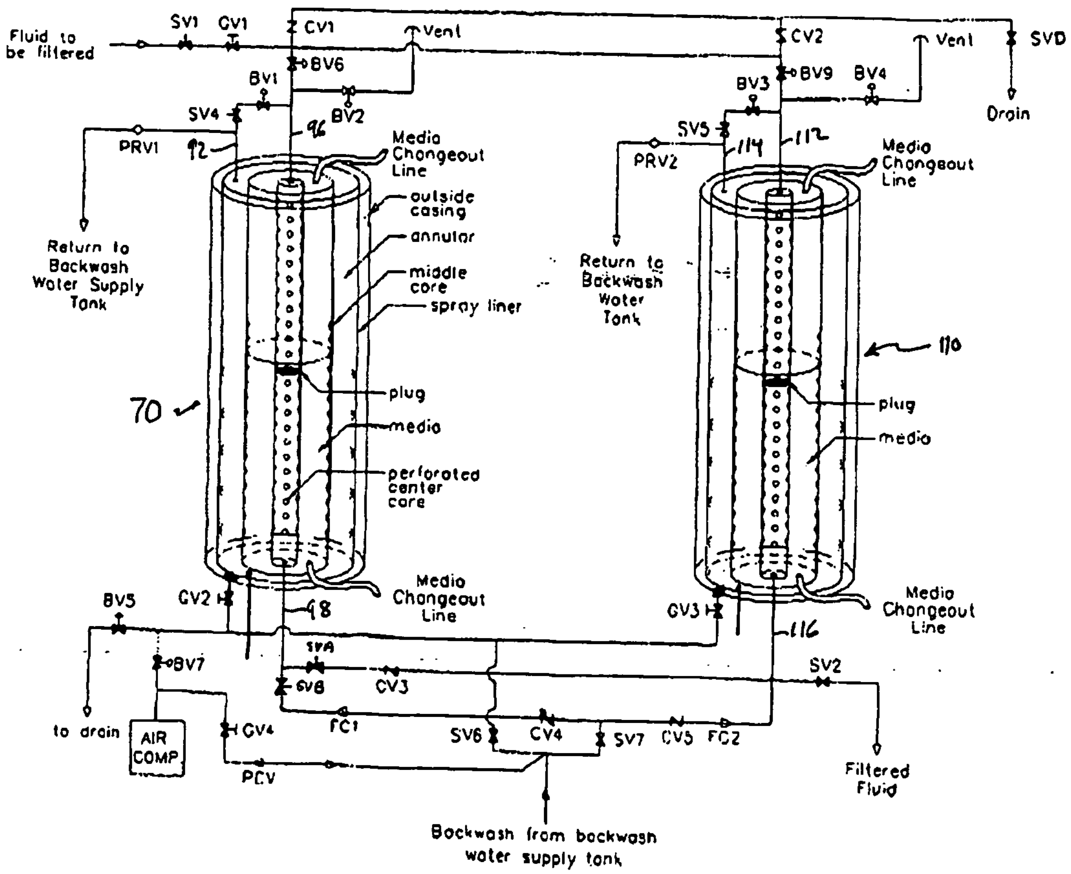
1. ALL LINES ARE 25mm DIA. (1") UNLESS NOTED OTHERWISE
2. MEDIA HEIGHT IN FILTER 750mm (29 1/2")
3. FOR MANUAL OPERATION CHANGE SOLENOID VALVES TO BALL VALVES AND DENOTE AS BSV

DUAL FILTERS IN SERIES

LEGEND	
SV	Solenoid Valve
MCV	Martin Check Valve
CV	Check Valve
GV	Gate Valve
BV	Ball Valve
FC	Flow Control
PCV	Pressure Control

FILTER SPECIFICATIONS
TOTAL LENGTH = 1782mm (70 3/16")
OUTSIDE DIAMETER = 168.3mm (6 5/8")
HEIGHT OF FILTER = 750mm (29 1/2")
HEIGHT OF PERFORATED AREA BELOW PLUG = 660mm (26")
SURFACE AREA FOR FILTRATION = 0.23m² (2.5ft²)

FIG. 6



NOTES:

1. ALL LINES ARE 25mm DIA. (1") UNLESS NOTED OTHERWISE
2. MEDIA HEIGHT IN FILTER 750mm (29 1/2")
3. FOR MANUAL OPERATION CHANGE SOLENOID VALVES TO BALL VALVES AND DENOTE AS BSV

DUAL FILTERS IN PARALLEL

FIG. 7 FILTER CYCLE

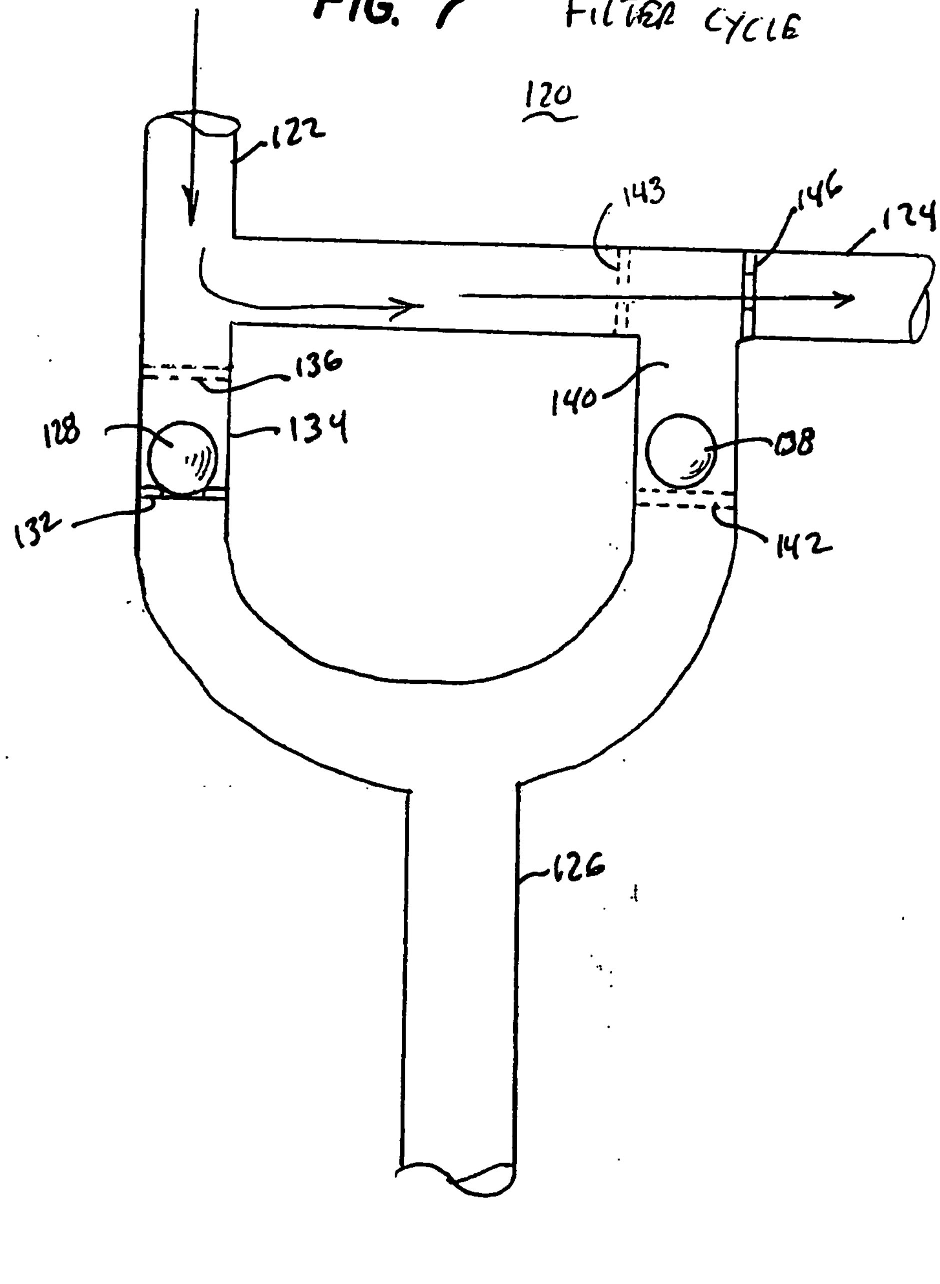


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FIG. 8

BACKWASH CYCLE